G3516B

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER - STAGE 2 INLET (°F):	130	FUEL:	NATURAL GAS
AFTERCOOLER - STAGE 1 INLET (°F):	201	FUEL SYSTEM:	CAT WIDE RANGE WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210		
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig): (See note 1)	7.0-40.0
COOLING SYSTEM:	JW+OC+1AC, 2AC	FUEL METHANE NUMBER:	80
CONTROL SYSTEM:	ADEM3	FUEL LHV (Btu/scf):	905
EXHAUST MANIFOLD:	DRY	ALTITUDE CAPABILITY AT 100°F INLET AIR TEMP. (ft):	4000
COMBUSTION:	LOW EMISSION		
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	2	bhp	1380	1035	690
ENGINE EFFICIENCY	(ISO 3046/1)	3	%	34.8	32.5	30.3
ENGINE EFFICIENCY	(NOMINAL)	3	%	34.2	31.9	29.7

ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	4	Btu/bhp-hr	7301	7820	8399
FUEL CONSUMPTION	(NOMINAL)	4	Btu/bhp-hr	7443	7972	8562
AIR FLOW (77°F, 14.7 psia)	(WET)	5, 6	ft3/min	3126	2452	1715
AIR FLOW	(WET)	5, 6	lb/hr	13862	10874	7602
FUEL FLOW (60ºF, 14.7 psia)			scfm	189	152	109
COMPRESSOR OUT PRESSURE			in Hg(abs)	103.8	91.8	69.4
COMPRESSOR OUT TEMPERATURE			°F	381	354	274
AFTERCOOLER AIR OUT TEMPERATURE			°F	133	133	131
INLET MAN. PRESSURE		7	in Hg(abs)	94.6	76.8	54.0
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	8	°F	146	146	143
TIMING		9	°BTDC	30	29	24
EXHAUST TEMPERATURE - ENGINE OUTLET		10	°F	992	986	1006
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	11, 6	ft3/min	9126	7138	5065
EXHAUST GAS MASS FLOW	(WET)	11, 6	lb/hr	14380	11290	7900

EMISSIONS DATA - ENGINE OUT					
NOx (as NO2)	12,13	g/bhp-hr	0.50	0.50	0.50
CO	12,14	g/bhp-hr	2.43	2.61	2.56
THC (mol. wt. of 15.84)	12,14	g/bhp-hr	4.77	5.11	5.19
NMHC (mol. wt. of 15.84)	12,14	g/bhp-hr	0.72	0.77	0.78
NMNEHC (VOCs) (mol. wt. of 15.84)	12,14,15	g/bhp-hr	0.48	0.51	0.52
HCHO (Formaldehyde)	12,14	g/bhp-hr	0.44	0.43	0.42
CO2	12,14	g/bhp-hr	474	506	549
EXHAUST OXYGEN	12,16	% DRY	9.0	8.7	8.3
LAMBDA	12,16		1.68	1.64	1.60

ENERGY BALANCE DATA					
LHV INPUT	17	Btu/min	171179	137505	98460
HEAT REJECTION TO JACKET WATER (JW)	18,26	Btu/min	23412	21533	19930
HEAT REJECTION TO ATMOSPHERE	19	Btu/min	6110	5092	4074
HEAT REJECTION TO LUBE OIL (OC)	20,26	Btu/min	4475	3978	3363
HEAT REJECTION TO EXHAUST (LHV TO 77°F)	21,22	Btu/min	62427	48810	34853
HEAT REJECTION TO EXHAUST (LHV TO 350°F)	21	Btu/min	41619	32383	23415
HEAT REJECTION TO A/C - STAGE 1 (1AC)	23,26	Btu/min	10046	8308	2813
HEAT REJECTION TO A/C - STAGE 2 (2AC)	24,27	Btu/min	5358	5063	3334
PUMP POWER	25	Btu/min	833	833	833

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	14	20	30	35	40	45	50	55	60	65	70	75	80	85
SET POINT TIMING	27	27	27	27	27	28	28	28	28	30	30	30	30	30
DERATION FACTOR	0.50	0.65	0.90	0.92	0.97	1	1	1	1	1	1	1	1	1

ALTITUDE DERATION FACTORS AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	1	1	1	0.95	0.91	0.86	0.81	0.77	No Rating	No Rating	No Rating	No Rating
120	1	1	1	1	0.97	0.92	0.87	0.83	0.78	No Rating	No Rating	No Rating	No Rating
110	1	1	1	1	0.98	0.94	0.89	0.84	0.79	No Rating	No Rating	No Rating	No Rating
100	1	1	1	1	1	0.95	0.90	0.85	0.80	0.75	No Rating	No Rating	No Rating
90	1	1	1	1	1	0.97	0.91	0.86	0.80	0.75	No Rating	No Rating	No Rating
80	1	1	1	1	1	0.99	0.94	0.89	0.84	0.78	No Rating	No Rating	No Rating
70	1	1	1	1	1	1	0.95	0.90	0.85	0.80	0.75	No Rating	No Rating
60	1	1	1	1	1	1	0.95	0.90	0.85	0.80	0.75	No Rating	No Rating
50	1	1	1	1	1	1	0.95	0.90	0.85	0.80	0.75	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.31	1.36	1.40	1.45	1.50	1.55	1.55	1.55	1.55	No Rating	No Rating	No Rating	No Rating
120	1.25	1.29	1.34	1.39	1.44	1.49	1.49	1.49	1.49	No Rating	No Rating	No Rating	No Rating
110	1.18	1.23	1.28	1.32	1.37	1.42	1.42	1.42	1.42	No Rating	No Rating	No Rating	No Rating
100	1.12	1.17	1.21	1.26	1.30	1.35	1.35	1.35	1.35	1.35	No Rating	No Rating	No Rating
90	1.06	1.10	1.15	1.19	1.24	1.29	1.29	1.29	1.29	1.29	No Rating	No Rating	No Rating
80	1	1.04	1.08	1.13	1.17	1.22	1.22	1.22	1.22	1.22	No Rating	No Rating	No Rating
70	1	1	1.02	1.06	1.11	1.15	1.15	1.15	1.15	1.15	1.15	No Rating	No Rating
60	1	1	1	1	1.04	1.09	1.09	1.09	1.09	1.09	1.09	No Rating	No Rating
50	1	1	1	1	1	1.02	1.02	1.02	1.02	1.02	1.02	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1050	1050	1050	1050	1050	1050	1050	1050	1050	No Rating	No Rating	No Rating	No Rating
120	1050	1050	1050	1050	1050	1050	1050	1050	1050	No Rating	No Rating	No Rating	No Rating
110	1050	1050	1050	1050	1050	1050	1050	1050	1050	No Rating	No Rating	No Rating	No Rating
100	1050	1050	1050	1050	1050	1050	1050	1050	1050	1230	No Rating	No Rating	No Rating
90	1050	1050	1050	1050	1050	1050	1050	1050	1050	1230	No Rating	No Rating	No Rating
80	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	No Rating	No Rating	No Rating
70	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1230	No Rating	No Rating
60	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1230	No Rating	No Rating
50	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1230	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:
This table shows the derate factor and full load set point timing required for a given fuel. Note that deration and set point timing adjustment may be required as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation.

ALTITUDE DERATION FACTORS:
This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site. The derate factors shown do not account for the external cooling system capacity. The derate factors provided assume the external cooling system can maintain the specified cooling water temperatures at site conditions.

ACTUAL ENGINE RATING:
To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).
1) Fuel Usage Guide Deration
2) 1-((1-Altitude/Temperature Deration) + (1-RPC))

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):
To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See notes 26 and 27 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):
This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed's Torque for the given ambient conditions. For some ambient conditions, the engine is not capable of being loaded continuously from idle to the max site torque at the indicated speed.

NOTES:
1. Fuel pressure range specified is to the engine fuel pressure regulator. Additional fuel train components should be considered in pressure and flow calculations.
2. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
3. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 3.0% of full load % efficiency value.
4. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 3.0% of full load data.
5. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
6. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
7. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
8. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
9. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
10. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
11. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
12. Emissions data is at engine exhaust flange prior to any after treatment.
13. NOx values are the maximum values expected under steady state conditions.
14. CO, CO2, THC, NMHC, NMNEHC, and HCHO are the maximum values expected under steady state conditions. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
15. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
16. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
17. LHV rate tolerance is ± 3.0%.
18. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
19. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
20. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
21. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
22. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
23. Heat rejection to A/C - Stage 1 based on treated water. Tolerance is ±5% of full load data.
24. Heat rejection to A/C - Stage 2 based on treated water. Tolerance is ±5% of full load data.
25. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
26. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (OC x 1.2) + (1AC x 1.05) + [0.9 x (1AC + 2AC) x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
27. Total Second Stage Aftercooler Circuit heat rejection is calculated as: (2AC x 1.05) + [(1AC + 2AC) x 0.1 x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

FREE FIELD MECHANICAL & EXHAUST NOISE

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1380	100	116.2	79.2	77.2	80.1	80.6	89.3	88.1	92.5	95.7	95.8	98.7
1035	75	115.4	78.0	76.9	79.1	79.6	88.1	86.9	92.4	95.4	95.9	99.5
690	50	113.2	74.7	74.2	76.5	77.5	86.0	84.6	90.3	94.7	94.8	98.2

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1380	100	101.7	102.2	98.7	100.7	101.8	96.8	96.6	96.6	94.1	105.6	115.2
1035	75	102.6	103.3	100.4	103.0	104.5	101.0	104.8	104.3	106.2	109.2	103.9
690	50	101.2	103.5	99.0	102.1	102.8	100.9	104.0	103.4	103.8	102.4	102.1

EXHAUST: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1380	100	130.0	101.4	99.0	106.2	105.5	100.7	97.7	98.5	101.7	108.5	113.2
1035	75	120.5	100.2	99.1	103.8	101.6	97.4	95.2	95.3	98.7	104.5	110.1
690	50	117.8	99.3	96.7	101.7	97.8	95.1	92.6	94.9	98.2	103.3	107.4

EXHAUST: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1380	100	113.0	112.0	114.7	119.7	122.4	120.3	121.2	122.5	120.8	118.8	116.9
1035	75	111.0	103.2	105.3	106.1	107.2	109.1	111.0	110.9	111.2	110.5	107.4
690	50	101.5	101.4	102.7	102.4	105.4	107.5	108.7	108.6	108.2	107.8	107.3

SOUND PARAMETER DEFINITION:
Sound Power Level Data - DM8702-03

Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 3747. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 3747 and ISO 6798 for mechanical and exhaust sound level only. Frequency bands outside the displayed ranges are not measured, due to physical test, and environmental conditions that affect the accuracy of the measurement. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.